

Free Energy Practice Problems

- 1) Calculate ΔG° at 45°C for reactions for which
 - (a) $\Delta H^\circ = -79.9 \text{ kJ}$, $\Delta S^\circ = 433.1 \text{ J/K}$
 - (b) $\Delta H^\circ = 837.4 \text{ kJ}$, $\Delta S^\circ = 173.8 \text{ J/K}$
 - (c) $\Delta H^\circ = -34.9 \text{ kJ}$, $\Delta S^\circ = -0.039 \text{ kJ/K}$
- 2) For a certain chemical reaction, $\Delta H^\circ = -35.4 \text{ kJ}$ and $\Delta S^\circ = -85.5 \text{ J/K}$.
 - (a) Is the reaction exothermic or endothermic?
 - (b) Does the reaction lead to an increase or decrease in the disorder of the system?
 - (c) Calculate ΔG° .
 - (d) At which temperature is the reaction spontaneous?
- 3) Using Appendix 4 on A19 in the back of your textbook, calculate ΔG° for the following reactions. Indicate whether each reaction is spontaneous.
 - (a) $2 \text{ SO}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2 \text{ SO}_3 (\text{g})$
 - (b) $6 \text{ Cl}_2 (\text{g}) + 2 \text{ Fe}_2\text{O}_3 (\text{s}) \rightarrow 4 \text{ FeCl}_3 (\text{s}) + 3 \text{ O}_2 (\text{g})$
- 4) For the reaction: $2 \text{ H}_2\text{O} (\text{l}) + 2 \text{ Cl}^- (\text{aq}) \rightarrow \text{H}_2 (\text{g}) + \text{Cl}_2 (\text{g}) + 2 \text{ OH}^- (\text{aq})$
 - (a) Calculate ΔG° at 25°C .
 - (b) Calculate ΔG at 25°C when $P (\text{H}_2) = P (\text{Cl}_2) = 0.250 \text{ atm}$, $[\text{Cl}^-] = 0.335 \text{ M}$ and the pH of the solution is 11.98.
- 5) Given that ΔH° for $\text{HF} (\text{aq})$ is -320.1 kJ/mol and ΔS° is 88.7 J/Kmol , find K_a for $\text{HF} (\text{aq})$ at 25°C .